

slope, and cools by radiation faster than it warms up by compression and insolation.

According to another, these are horizontal protrusions southward from the great areas of cold air lying close to the ground in Arctic America. It is supposed that only a very thin lower layer is drawn southward by the development of areas of low pressure in Tropical America, the Gulf States, and the West Indies.

According to a third theory, there is a cold upper anti-trade flowing from equatorial regions to the Arctic on a gradient so gentle that its clear air cools to the lowest temperatures—so low that, when it finally descends in latitudes 50° to 70° , its warming by compression does not raise its temperature above the -50° or -30° that is observed in our severest cold waves.

It may well be that all three of these views must be combined together in order to explain the actual processes of nature. Doubtless we shall need to obtain more data from the upper air by means of kites and balloons, but meanwhile Prof. R. F. Stupart has directed attention toward the possibility of compiling daily weather maps extending northward beyond the Arctic Circle as being the first requisite to the successful study of the question, and we print as Charts IX–XIV of this Review a series of his maps for January 13–18, 1904, as illustrating what is now possible in this line of work. There is no doubt but that steady progress will be made in filling up the blank spaces over the great frozen region of North America, and that eventually the charts will abundantly represent the conditions at the lower level of the atmosphere. But the data for upper levels will, we fear, still be rather scanty, so that for these we shall necessarily rely upon deduction rather than observation.

Even now, however, we already perceive many analogies between these North American maps and those of Europe and Asia, so that these combined with similar ocean maps represent one simple mechanical circulation. We must learn to study the whole Northern Hemisphere, or the whole globe, on a globular surface instead of on the plane surfaces that are offered by our various misleading styles of cartographic projection.—C. A.

METEOROLOGY IN AUSTRIA.

The Imperial Centralanstalt for Meteorology and Geodynamics published its first annual volume, or Jahrbuch, for the year 1855, and a new series began with 1863. Many of these volumes contain not merely elaborate climatological data, but additional material, sometimes published as an Anhang, or Appendix, and we make the following notes on the appendix to the volume for 1904, which was received during August, 1906.

MEAN ATMOSPHERIC PRESSURE.

The distribution of atmospheric pressure over central and southern Europe was the subject of an important memoir by Hann, published in 1887, in Volume II of Penck's Geographical Memoirs. Therein Hann mentions the difficulty of finding the stations at which the more important series of observations have been made, owing in part to frequent changes. In order to obviate this trouble Margules recommends that from time to time, if possible yearly, or at least every five years, the recent observations should be combined with the older series, thus maintaining a continual revision of the annual and monthly averages. He has, therefore, compiled the records that have accumulated since the close of Hann's work, viz, for nineteen years, 1886–1904, inclusive. In order that all may be reduced to an absolute standard of pressure he states that we must first have a station whose barometer has not changed during the whole interval, and in order to assure ourselves of this the barometers used at the central station must be compared annually with an absolutely correct barometer; but this, he says, has never been done in Austria,

and we believe we may add that it has not been done elsewhere. There are in fact, so far as we know, but three institutions in the world, viz, the Central Physical Observatory at St. Petersburg, the International Bureau of Weights and Measures, at Sèvres, near Paris, and the Bureau of Standards or Reichsanstalt, at Charlottenberg, near Berlin, that possess true normal barometers, so constructed that every imaginable source of error can be investigated. The barometric work done by meteorological offices thruout the world has not yet attained to a precision comparable with that attained in their own thermometric observations. Even the most accurate physicists investigating the properties of gases seem to be liable to assume the accuracy of their barometric work, while pushing the thermometric measurements to the highest refinements. The mercurial barometers used by meteorologists need careful calibration and frequent comparisons in order to enable us to detect the changes going on in their instrumental corrections.

Margules finds himself forced to assume that during these nineteen years the barometer of the Centralanstalt has remained correct and unchanged to within one-tenth of a millimeter. His first step is then to compare the annual mean pressures as observed at Vienna with the means observed at other stations near by at nearly the same level, and more especially those stations whose differences from Vienna have changed but little during the whole period. For instance, the station at Judenburg shows a departure from Vienna of -0.70 millimeters during the first seven years, -0.79 in the next five years, and -0.78 during the third lustrum. The greatest departure in the annual means was -0.95 and the least -0.63 . As there was no system in these variations this is called a constant series. The distance between the two stations is 165 kilometers, and the annual means are reduced to the same elevation, 200 meters above the sea level, before comparison. On the other hand an equally important station, Kremsmuenster, at a distance of 160 kilometers, showed the following differences for the successive lustra, namely, 16.38, 16.22, 16.08 millimeters, which looks as tho there had been a steady change in one or the other barometer. Similar systematic changes are found in other cases. These differences are partly explained as dependent upon the distances between the stations, and their directions from one another, in connection with an occasional abnormal distribution of pressure. Such abnormal deviations may have continued, in one case, for three consecutive years, when large barometric depressions lay for a long time to the south of Vienna. Margules concludes that these remarks will interest only the officials of the various meteorological institutions.

The annual volumes contain too many figures, and it is impossible to properly check the computations. Therefore if anyone wishes to use these published figures he must spend much labor in selecting what is best and most appropriate from this excess of material. If this preliminary checking is to be done systematically in the central offices it would result in diminishing the quantity of printed material. He thinks that atmospheric pressure has no direct climatological interest and might properly be published to a very limited degree only. For those purposes to which monthly means of pressure do apply it would suffice to have one station in the low lands, or one high and one low station in the mountain regions, for every circle of one hundred kilometers radius. This is very nearly the same as one barometric station to a circle whose radius is one degree of a great circle, or to every four square degrees, or about two hundred for the area covered by the United States. As there are some problems in the mechanics of the atmosphere that are peculiar to the orography of the North American Continent, we think that for the present at least, until these are solved, it is fortunate that the United States is in a position to publish monthly and annual means reduced to a uniform standard for all of its 175 baro-

metric stations. Eventually, however, we shall undoubtedly be able to restrict this publication somewhat and follow out Margules: "If for certain special investigations a finer network of barometric stations is desired they certainly can be easily established, and then dissolved at the close of the work".

Hitherto the Weather Bureau has not attempted to forecast thunderstorms, hailstorms, and tornadoes, but if ever we should do this for special localities, such as our large cities, we should certainly need a much closer network of barometric stations than at present.

THUNDERSTORMS, LIGHTNING, AND HAIL.

The observations of thunderstorms and hail in upper Austria, during the year 1904, have been summarized by Prof. R. Prohaska. The total number of stations was 426, and the number of reports 17,850 thunderstorms, with 1578 additional reports of distant lightning or heat lightning. The average number of thunderstorms per station was 42.7 for the year 1904, being the highest since the series of reports began. The next highest was 37.9 in 1889; the lowest was 27.0 in 1900 and also in 1902. The regular registration of hail began in 1888; the average number of hailstorms per station during the fourteen years was 2.3; the maximum number was 3.6 for this same year, 1904. Hailstorms occur in long narrow streaks; out of 46 cases that were examined the length of the streak varied between twenty and two hundred kilometers, while the average width was from five to fifteen kilometers. The fronts of the hailstorms advanced with an average velocity of from thirty to forty-five kilometers per hour. Hailstones having large diameters occurred as follows:

| Diameters—centimeters. | Frequency—days. |
|------------------------|-----------------|
| $\frac{1}{2}$ | 18 |
| 1..... | 24 |
| 2..... | 12 |
| 3..... | 6 |
| 4..... | 4 |
| 5..... | 4 |
| 7..... | 3 |
| 8..... | 2 |
| 10..... | 1 |

As ten centimeters is practically the same as four inches, the reader will see that the agriculturists of Austria probably suffer more from hail than those of the United States.

With regard to lightning strokes Prohaska states that an unusual number of strokes, viz, 807, were reported in 1904, of which 95 related to injuries to persons, 115 to domestic animals, 179 to trees, 177 to buildings set on fire by the lightning, 114 to the so-called "cold strokes", which injure, but do not set the buildings on fire, and 127 miscellaneous.

GENERAL INDEX.

Doctor Forster, librarian of the Centralanstalt, publishes a general register of the contents of the annual Jahrbucher of the Centralanstalt for the years 1864-1903. This occupies only six pages, but will be continually referred to by those who need to use the data contained in these volumes. We hope that every other national weather bureau will publish similar registers.—C. A.

MOUNTAIN STATIONS FOR FORECAST WORK.

The study by Mr. McLeod and Professor Barnes published on a previous page is analogous to those made by myself in my efforts to utilize the observations made on Mount Washington in daily forecast work. That station was maintained for seventeen years, and during the latter part of this period at my earnest request, since I was frequently able to forecast weather changes by means of observations telegraphed daily from the summit. Eventually, however, the station was discontinued, as the cost seemed to be not fully compensated by the value of the work. Professor Hazen condensed the records as to temperature and pressure into a series of graphic dia-

grams, and copies of these for the months of January, February, and March, for the years 1871-1886, were published in the MONTHLY WEATHER REVIEW for July, August, September, and October, 1891, with a few words of explanatory text on pages 171 of the July REVIEW and 250 of the October REVIEW. This was done in connection with a long discussion distributed thru various meteorological journals on the question whether the air temperature in areas of low pressure is higher or lower than in areas of high pressure, and the diagrams contributed somewhat to modify our ideas on that subject. The lag of the temperature changes in the lower strata behind those in the upper strata, which had been inferred by me from the early years of our work, does not appear so plain when we take the whole series into consideration.

In the MONTHLY WEATHER REVIEW, October, 1891, page 250, Professor Hazen says:

As has been noted before, the most marked characteristic in the temperature curves has been their closeness at base and summit, indicating, apparently, a general effect not essentially modified by local causes. The earlier change at the summit in both cold waves and hot waves is remarkable, and does not seem to be due, as has been suggested, to the greater rapidity of the upper current which carries the warm or cold air from the west more rapidly to the summit than to the base. It will be seen that any effect of this kind would be very quickly obliterated by the motion of the air. Again, while on some accounts warm air from the earth's surface might produce such an effect, it would seem that cold air could not have this source, but must come from above.

Professor Hazen's diagrams give us not the actual temperatures, but the temperatures corrected for average diurnal range, and it is very desirable that a renewed study of these valuable data be made from Professor Barnes's point of view. This and many other studies could be carried out if the observations at summit and base were published in full, as has been done for Pikes Peak.—C. A.

WEATHER BUREAU MEN AS EDUCATORS.

Classes from high schools and academies have visited Weather Bureau offices, to study the instruments and equipment and receive informal instruction, as reported from the following offices:

Columbus, Ohio, November 16, 1906, a class from the South High School.

Mobile, Ala., October 12, and November 21 and 27, 1906, classes from Barton Academy.

Pensacola, Fla., October 19, 1906, scholars from High School No. 1.

Spokane, Wash., November 7, 8, 9, and 13, 1906, the physical geography class of the Spokane High School, in sections.

MONTHLY REVIEW OF THE PROGRESS OF CLIMATOLOGY THRUOUT THE WORLD.

C. FITZHUGH TALMAN, U. S. Weather Bureau.

METEOROLOGICAL STATIONS IN HAITI.

The accompanying chart, fig. 1, shows the location of all meteorological stations now in operation in Haiti. This chart has been corrected, in the manuscript, by Prof. Josef Scherer, of the Collège St. Martial, Port au Prince, whose labors in behalf of Haitian meteorology are well known to many readers of the REVIEW. All the stations shown on the chart, except one, report their observations to Professor Scherer, who publishes them regularly in his "*Bulletin mensuel de la Station Météorologique de Port au Prince, Haiti*". The elaborate observations made at the central observatory, Port au Prince, are published also in the Jahrbuch of the Centralanstalt für Meteorologie, Vienna, and in the Annales du Bureau Central Météorologique de France.

The climate of Port au Prince has been quite fully investigated by Scherer and Hann, and a large body of normals for this station now exists. (See the Anhang to the Vienna Jahrbuch for 1893; Meteorologische Zeitschrift, March, 1897,